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OpenPath Sequence Service Increases Oil Production by 70% in Mature Deviated Well, Kazakhstan

Engineered matrix treatment also increases gas production 145% by ensuring thorough stimulation of the long, heterogeneous interval

CHALLENGE

Improve oil and gas production from a long interval in a depleted cased-hole carbonate well without mechanical isolation hardware or coiled tubing assistance.

SOLUTION

Design and deliver an enhanced acid treatment using SDA* self-diverting acid and OpenPath Sequence* diversion stimulation service with engineered composite pills.

RESULTS

Increased oil production from 20 to 34 m^3/d [126 to 214 bbl/d] and gas production from 29 to 71 m^3/d [1,024 to 2,507 cf/d] in the target formation.

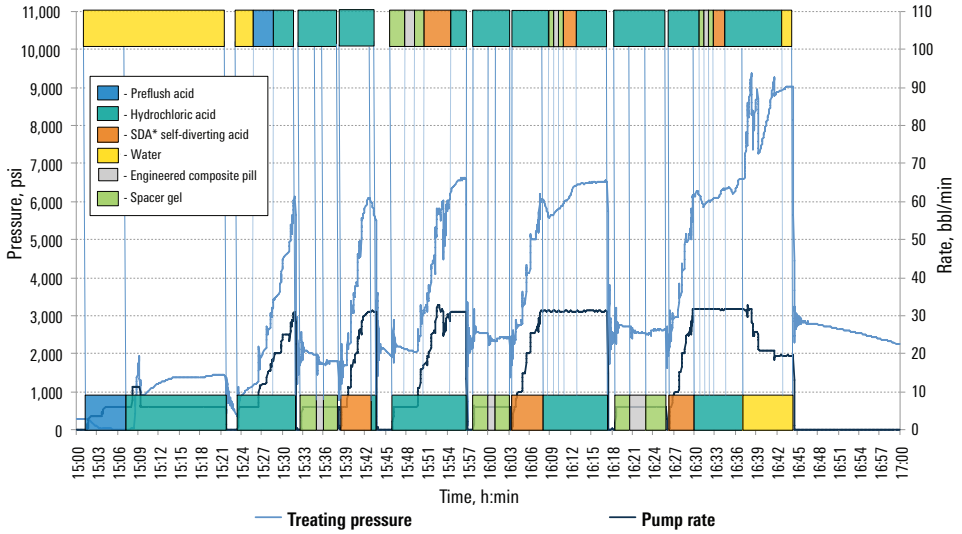
Oil and gas production decline in mature well

In 2013, after drilling a long deviated well through a carbonate formation in western Kazakhstan, the operator stimulated production by bullheading a conventional acid treatment with a self-diverting acid system. Production improved but did not meet expectations.

After 4 years, hydrocarbon production began to decline below economic limits, and the operator considered restimulation options. A PLT log run in early 2017 identified several intervals with minimal or no contribution to production; generally, the worst performers had the lowest porosity and permeability, according to the post-drilling openhole logs.

The operator believed that the gross interval of 288 m [945 ft] was too long and heterogeneous to stimulate thoroughly without mechanical diversion. However, economics eliminated the possibility of using coiled tubing or rig-assisted selective acidizing. In addition, the operator wanted to minimize the volume of water-based fluid pumped into the depleted formation to limit flowback time and nitrogen lifting requirements.

Nearby wells had also experienced emulsions and sludging after acid stimulation, so it was critical to verify fluid and additive compatibility with formation rock and fluids. Finally, it was important to ensure that all materials, including mechanical diversion pills, would degrade or flow back at the relatively low downhole temperature (70 degC [160 degF]) without damaging formation permeability.



The matrix treatment design included four cycles of HCl and three cycles of composite pills and SDA acid to ensure complete stimulation of the heterogeneous formation.

Diversion service distributes fluid more thoroughly

After testing fluid and additive compatibility, tubing corrosion, and composite pill degradation under the downhole conditions, Schlumberger recommended an OpenPath Sequence diversion stimulation service with a low volume of SDA self-diverting acid as a fit-for-purpose treatment design.

To ensure stimulation of the entire interval, the engineers designed and modeled a treatment schedule to isolate high-permeability zones and natural fractures with engineered, acid-compatible composite pills so subsequent fluid would stimulate lower-permeability zones. The stimulation design also reduced the volume of acid required to achieve thorough stimulation.

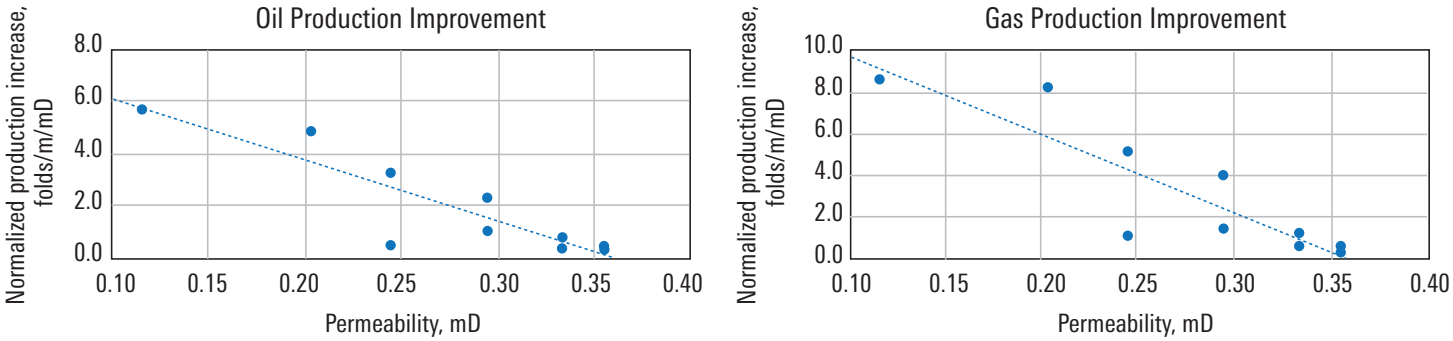
Production increases—especially in low-permeability zones

The treatment was pumped as designed with an acid preflush followed by four cycles of hydrochloric acid, three cycles of composite pills and SDA acid, and displacement.

Clean-up time after the treatment was 20% faster because of the reduced volume of SDA acid as compared with previous treatments in the area. No sludges or emulsions have been seen. Some partially degraded composite pill components (particulates or fibers) were seen in the flowback tanks; all of them degraded within 1 week at ambient temperature, confirming that any material left in the formation—at higher temperature—would have fully degraded.

After cleanup, the well's oil production increased 70% from 20 to 34 m^3/d [126 to 214 bbl/d], and gas production increased 145% from 29 to 71 m^3/d [1,024 to 2,507 cf/d] in the stimulated interval.

After hydrocarbon flow stabilized, the operator ran a production logging tool to determine the final flow. With no diversion or poor diversion, the high-permeability zones would receive most of the fluids and therefore deliver the most production improvement. Based on the production data for this well, however, the production improvement is highest in lower-permeability zones, which confirms the diversion technology prevented overtreating the high-permeability and naturally fractured zones.



Poststimulation logging determined that production improved more in low-permeability areas than in high-permeability areas, confirming that the engineered OpenPath Sequence service diverted the stimulation fluids as designed.

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